Assessing vulnerability of urban African communities using multi-dimensional indicators selected by stakeholders

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Assessing vulnerability of urban African communities
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Many East African cities are in the process of assessing their vulnerabilities to climate change, but face difficulties in capturing the complexity of the various facets of vulnerability. This holistic approach, captures four different dimensions of vulnerability to flooding - Assets, Institutions, Attitudes and the Physical environment, with Dar es Salaam, Tanzania, as a case city.

The methodology is actively involving the expertise of the stakeholders, and uses GIS to analyze and compile the data. The final output is presented as a comprehensible map, delineating the varying vulnerability to flooding across the city, at the finest administrative level.

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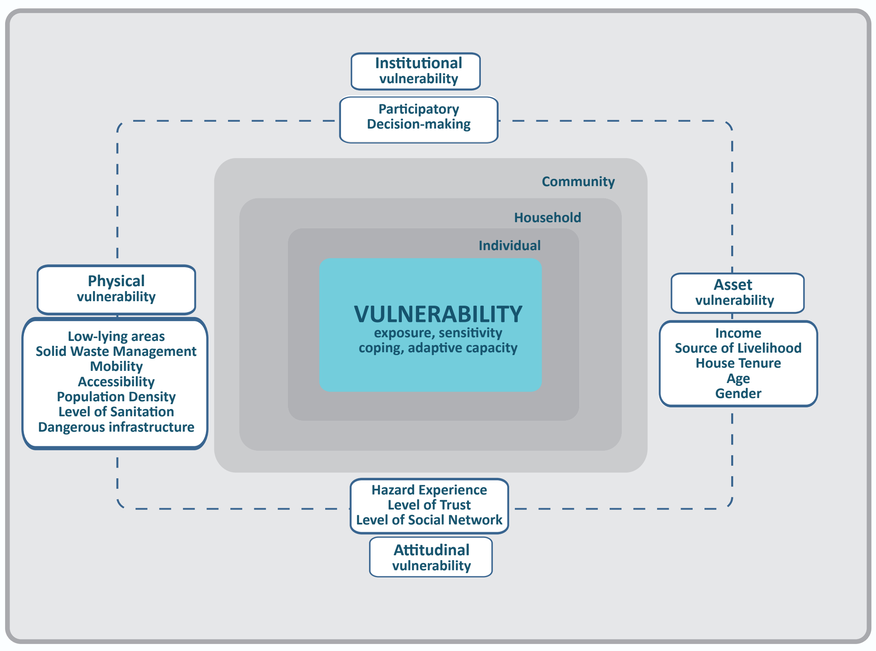
THEORETICAL FRAMEWORK

The framework of vulnerability to recurrent flooding in urban African communities includes four dimensions that put together may reveal the degree to which communities may anticipate, resist, cope and recover from flooding:

- **Asset:** encompasses the human livelihood and material resources of individuals and groups.
- **Institutional:** refers to the state of local authorities and civil action groups that operate to prevent, adapt or mitigate the effect of extreme weather events.
- **Attitudinal:** conveys the perception and risk management attitude of individuals and groups.
- **Physical:** is determined by the characteristics of the built environment and the land cover, may it be natural and/or man-made.

(Jean-Baptiste *et al.,* 2013)



STAKEHOLDER INTERACTION

Through a participatory process, multi-level and sector stakeholders collectively selected and weighted 16 indicators of vulnerability to flooding, relevant to the city of Dar es Salaam. This work also included:

- **Translating** the indicators into the real-world situation of Dar es Salaam.
- **Explaining** how the chosen indicators best would be measured to give meaning locally, especially when working with 'intangible' indicators (*e.g.* how to quantify an indicator like Hazard Experience).
- **Indicating** what data to use and where to find it, if already available (*e.g.* surveys, registries).

METHODOLOGY

General inventory of vulnerability indicators

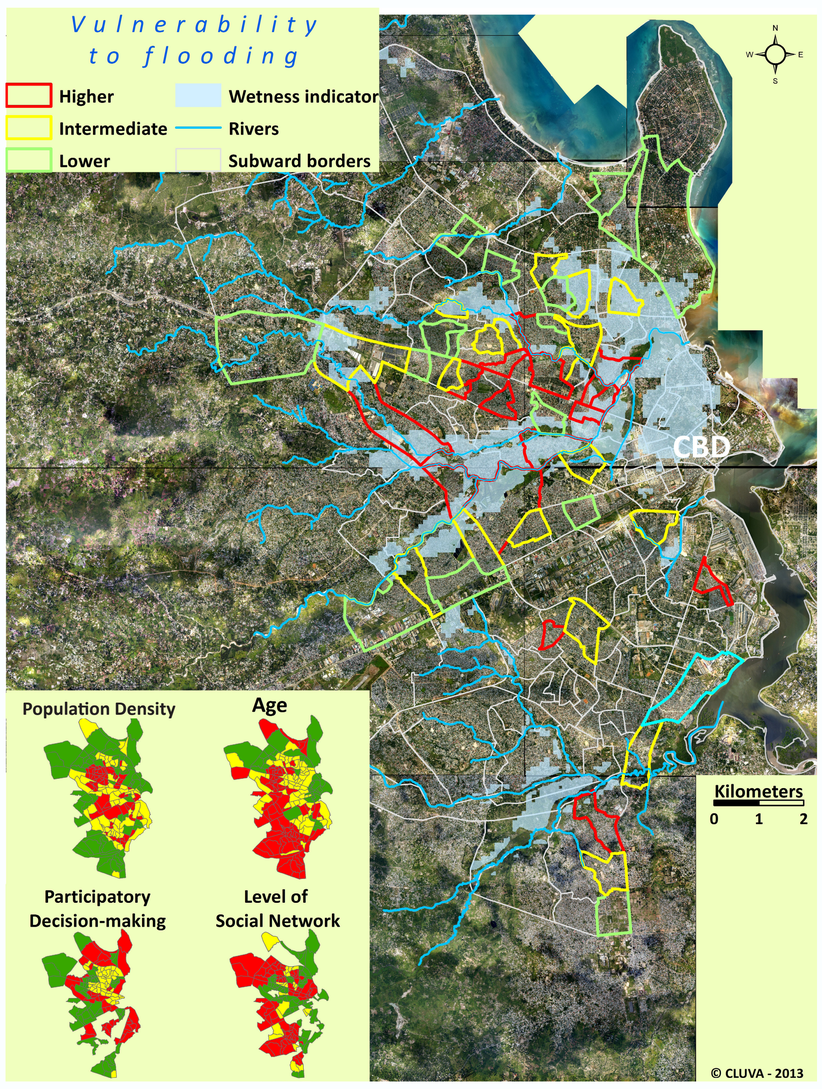
1st reduction: Hazard type-specific indicators

2nd reduction: City-specific indicators

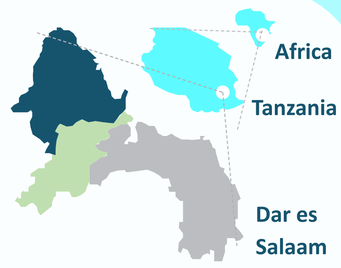
Weighting of indicators

Data collection and analysis – geomatics, surveys, registries

Aggregated vulnerability assessment



The light-blue areas are more likely to be flooded (Topographical Wetness Index - TWI, De Paola/AMRA, 2012).
The CBD (Central Business District) is indicating the city center.



GIS OUTPUT - City Level

The estimated multi-dimensional vulnerability to flooding shown as coloured polygons, ranging from higher, via intermediate to lower vulnerability.
(The polygons are representing the lowest administrative level of Dar es Salaam - the subwards).

The large map displays the overlap of 16 vulnerability indicators.
In the lower left corner are some examples of the separate vulnerability indicator maps, one from each dimension:

* **Asset -** Age
  (% of children aged 0-4 years)
* **Institutional -** Participatory Decision-making
  (Frequency of subward and committee meetings)
* **Attitudinal** - Level of Social Network
  (No. of formal groups)
* **Physical -** Population Density
  (No. of people per m2 settlement)

(Karlsson Nyed and Herslund, 2013)

The results indicated that vulnerability is strongly associated with the informal areas-dominated subwards. Moreover, in the peripheral informal areas vulnerability was associated with high scores of the Asset dimension indicators (*e.g.* Age), whereas closer to the city center higher vulnerability was related to the Physical dimension indicators, such as Low-lying areas and lacking urban infrastructures.

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